



Calvin, Giordano & Associates, Inc.
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Certificate of Authorization #514

CONCEPTUAL DRAINAGE CALCULATIONS

Biscayne Park - Phase 1A Drainage Design Criteria Package

(NE 11TH AVENUE)

Village of Biscayne Park, Florida

Prepared For:

Village of Biscayne Park

Prepared By:



Calvin, Giordano & Associates, Inc.

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August 2021

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Mohammed Sharifuzzaman, P.E.
FL P.E. License Number 67640



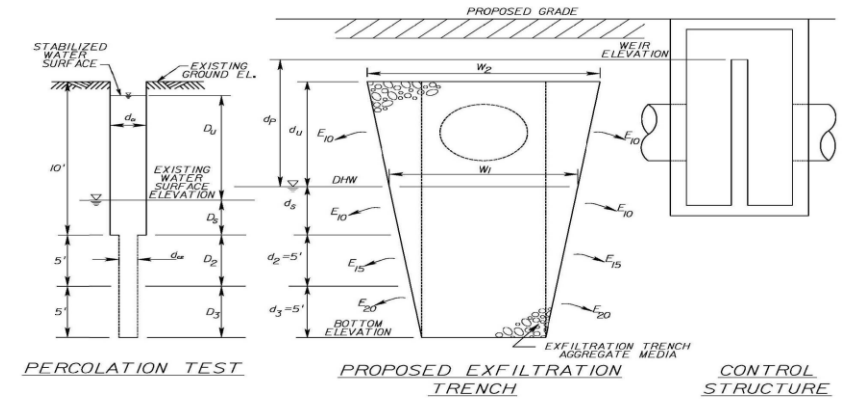
FRENCH DRAIN CALCULATIONS

(NE 11 AVE)

DESIGN ELEVATIONS:

Weir Elevation/control elevation	=	2 ft NGVD
Existing Grade Elevation	=	3 NGVD
Design High Water Elevation (DHW)	=	1.8 ft NGVD (October Water Table Elevation)
Top of Trench Elevation	=	1.8 ft NGVD
Bottom of Trench Elevation	=	-12.00 ft NGVD
Unsaturated Trench depth (d _u)	=	0 ft

EXFILTRATION RATE CALCULATIONS:



The design high water elevation and the control elevation are within the aggregate

media. E_t = Total exfiltration rate per foot of trench, cfs/LF

For 15-ft deep exfiltration trench:

$$E_t = 2 K_{10} [d_u (d_p - d_u/2) + d_s d_2] K_{15}$$

(Equation 2.6-2, Exfiltration Trench Reference Manual-January 2008, Florida Department of Transportation District-6)

K ₁₀ =	Hydraulic Conductivity at 10 ft depth =	1.88E-03 cfs/ft ² /ft of
K ₁₅ =	Hydraulic Conductivity at 15 ft depth =	1.88E-03 head cfs/ft ² /ft
d ₁ =	Depth of Trench within 10 ft stratum =	8.80 of head ft
d ₂ =	Depth of Trench within 10-15 foot Stratum =	5 ft

d _p =	Hydraulic Head on Exfiltration trench =	0.2 ft
d _u =	Depth of the Unsaturated Zone =	0 ft
d _s =	Depth of the Saturated Zone =	8.80 ft

$$E_t = \text{Total exfiltration rate per LF of trench (Calculated)} = 0.0104 \text{ cfs/LF}$$

$$E_t = \text{Total exfiltration rate per LF of trench (Design)} = 0.0104 \text{ cfs/LF}$$



FRENCH DRAIN CALCULATIONS

(NE 11 AVE)

EXFILTRATION LENGTH CALCULATIONS:

According to the Florida Department of Transportation - District 6 Exfiltration Trench Reference Manual, January 2008 - Ver.1.08, the Minimum Exfiltration Length Required to meet the Water Quality and Quantity for the design storm shall satisfy the following equations:

$$S L + 60 E_t L T_t = 60 C A_{\text{area}} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t \quad \text{.....Equation 3.3-10 } E_t L$$

$$= C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3]) \quad \text{.....Equation 3.3-11}$$

Where:

S = Storage in trench, ft³ per LF of trench

$$S = (W d_u - A - A_s) \times 0.5 + (A - A_s)$$

$$S = (W d_u - [\pi/4 D^2 - 1/2 r^2 (\theta/180 - \sin\theta)]) \times 0.5 + [\pi/4 D^2 - 1/2 r^2 (\theta/180 - \sin\theta)]$$

W = Average trench width =

4 ft

D = Diameter of perforated pipe =

1.5 ft

A = Available Storage area in perforated pipe =

1.767 ft²

A_s = Submerged area of pipe =

1.767 ft²

S = Storage in trench per LF of trench =	0.000 ft³/LF
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T_t = Time to generate one inch of runoff plus the time of concentration

$$T_t = T_{1''} + T_c$$

$$T_{1''} = \text{Time to generate 1" of runoff, minutes} = (2940 F^{-0.11}) / (308.5C - 60.5 (0.5895 + F^{-0.67}))$$

C = Weighted runoff coefficient

Pervious Area (A1) =

0.4 ac

Impervious Area (A2) =

0.4 ac

Total Area (A3) =

0.8 ac

Runoff coefficient Pervious (C1) =

0.25

Runoff coefficient Impervious (C2) =

0.95

C = [(A1 x C1) + (A2 x C2)] / A =	0.600
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A_{area} = Total Tributary Area = C x A3 =	0.48 ac
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F = Design Storm Frequency =

5 Year

T_{1''} =

19.11 Minutes

T_c = Time of concentration or time to reach 1 inlet =

10 Minutes

T_t = Time to generate one inch of runoff plus the time of concentration	29.11 Minutes
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Per Table 3.3-1 Excerpt of Table T-16 from the FDOT Hydrology Handbook - January 2004:

Within Rainfall Zone 10, in Miami-Dade County for a 10-year storm frequency, the polynomial coefficients

A = 11.1908

B = -0.93165

C = -0.48526

D = 0.05836

Equation 3.3-10: $S L + 60 E_t L T_t = 60 C A_{\text{area}} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t$

OR: $L = \{60 C A_{\text{area}} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t\} / (S + 60 E_t T_t)$

Equation 3.3-11: $E_t L = C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3])$ OR:

$$L = \{C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3])\} / E_t$$

Where:

L = Length of Exfiltration Trench, LF

t = Rainfall duration, min



FRENCH DRAIN CALCULATIONS

(NE 11 AVE)

Use Excel *Solver* to find t when $L_{3.3-10} = L_{3.3-11}$

$L_{3.3-10} = 536.38$ LF

$L_{3.3-11} = 536.38$ LF

$L_{3.3-10} - L_{3.3-11} = 0.00$

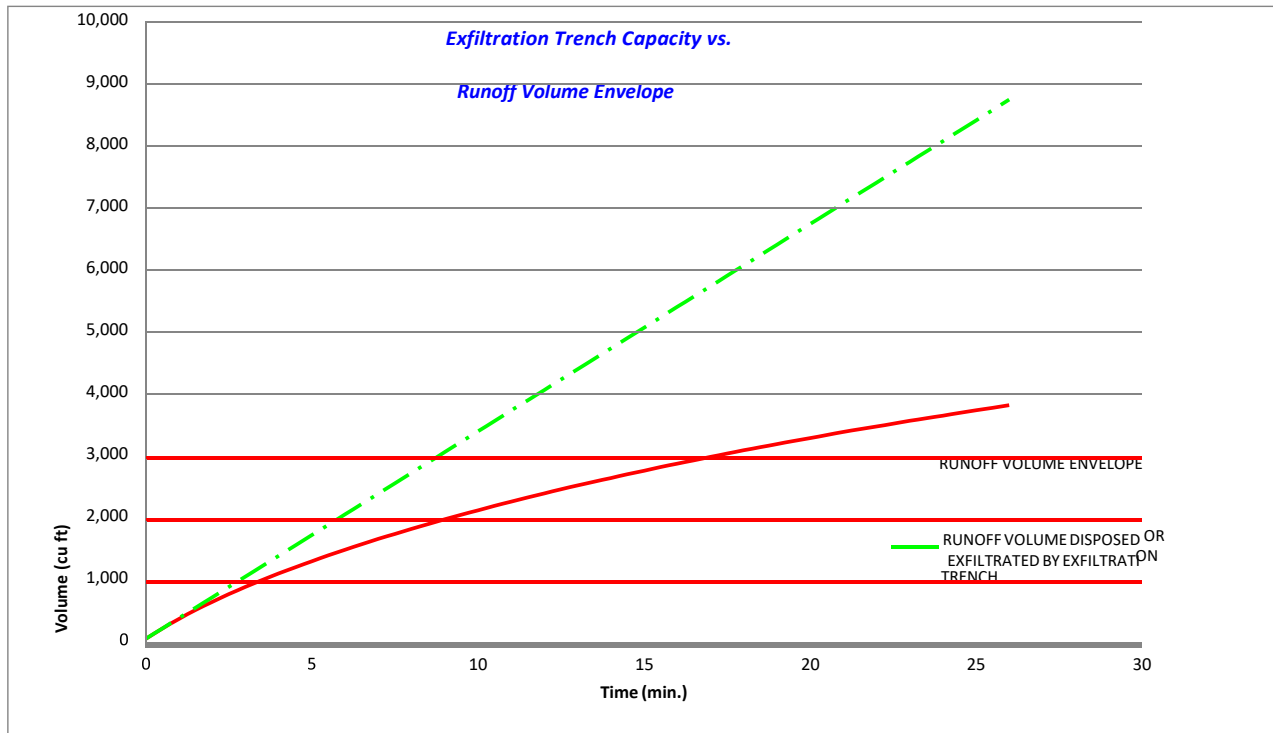
$t = 0.43$ Minutes

THEREFORE,

LENGTH OF EXFILTRATION TRENCH REQUIRED = 536.38 LF

LENGTH OF EXFILTRATION TRENCH PROVIDED = 591 LF

FACTOR OF SAFETY PROVIDED = 1.10





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CONCEPTUAL DRAINAGE CALCULATIONS

Biscayne Park - Phase 1A Drainage Design Criteria Package (NE 111TH STREET) Village of Biscayne Park, Florida

Prepared For:

Village of Biscayne Park

Prepared By:



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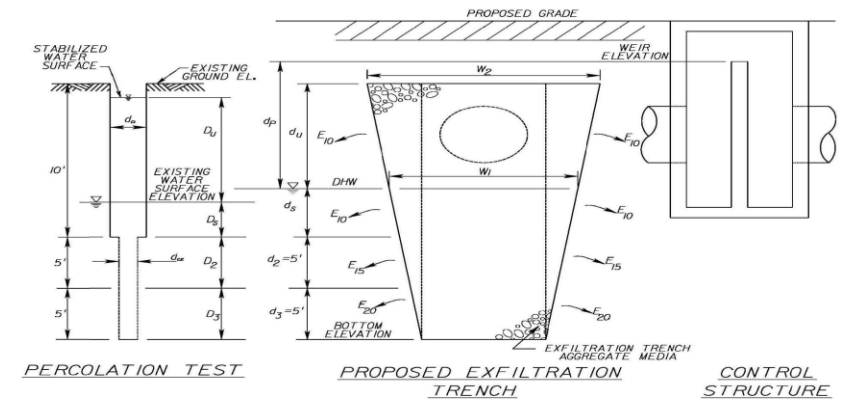
FRENCH DRAIN CALCULATIONS

(NE 111TH ST)

DESIGN ELEVATIONS:

Weir Elevation/control elevation	=	4 ft NGVD
Existing Grade Elevation	=	4 NGVD
Design High Water Elevation (DHW)	=	1.8 ft NGVD (October Water Table Elevation)
Top of Trench Elevation	=	3 ft NGVD
Bottom of Trench Elevation	=	-11.00 ft NGVD
Unsaturated Trench depth (d_u)	=	1.2 ft

EXFILTRATION RATE CALCULATIONS:



The design high water elevation and the control elevation are within the aggregate

media. E_t = Total exfiltration rate per foot of trench, cfs/LF

For 15-ft deep exfiltration trench:

$$E_t = 2 K_{10} [d_u (d_p - d_u/2) + d_s d_p] + 2 d_p d_2 K_{15}$$

(Equation 2.6-2, Exfiltration Trench Reference Manual-January 2008, Florida Department of Transportation District-6)

K_{10} =	Hydraulic Conductivity at 10 ft depth =	1.35E-04 cfs/ft ² /ft of
K_{15} =	Hydraulic Conductivity at 15 ft depth =	1.35E-04 head cfs/ft ² /ft
d_1 =	Depth of Trench within 10 ft stratum =	9.00 of head ft
d_2 =	Depth of Trench within 10-15 foot Stratum =	5 ft

d_p = Hydraulic Head on Exfiltration trench = 2.2 ft

d_u = Depth of the Unsaturated Zone = 1.2 ft

d_s = Depth of the Saturated Zone = 7.80 ft

E_t = Total exfiltration rate per LF of trench (Calculated) = 0.0081 cfs/LF

E_t = Total exfiltration rate per LF of trench (Design) = 0.0081 cfs/LF



FRENCH DRAIN CALCULATIONS

(NE 111TH ST)

EXFILTRATION LENGTH CALCULATIONS:

According to the Florida Department of Transportation - District 6 Exfiltration Trench Reference Manual, January 2008 - Ver.1.08, the Minimum Exfiltration Length Required to meet the Water Quality and Quantity for the design storm shall satisfy the following equations:

$$S L + 60 E_t L T_t = 60 C A_{area} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t \quad \text{.....Equation 3.3-10 } E_t L$$

$$= C A_{area} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3]) \quad \text{.....Equation 3.3-11}$$

Where:

S = Storage in trench, ft³ per LF of trench

$$S = (Wd_u - A - A_s) \times 0.5 + (A - A_s)$$

$$S = (Wd_u - [\pi/4 D^2 - 1/2 r^2 (\theta/180 - \sin\theta)]) \times 0.5 + [\pi/4 D^2 - 1/2 r^2 (\theta/180 - \sin\theta)]$$

W = Average trench width =

4 ft

D = Diameter of perforated pipe =

1.5 ft

A = Available Storage area in perforated pipe =

1.767 ft²

A_s = Submerged area of pipe =

1.767 ft²

S = Storage in trench per LF of trench =	2.400 ft³/LF
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T_t = Time to generate one inch of runoff plus the time of concentration

$$T_t = T_{1"} + T_c$$

$$T_{1"} = \text{Time to generate 1" of runoff, minutes} = (2940 F^{-0.11}) / (308.5C - 60.5 (0.5895 + F^{-0.67}))$$

C = Weighted runoff coefficient

Pervious Area (A1) =

0.15 ac

Impervious Area (A2) =

0.15 ac

Total Area (A3) =

0.3 ac

Runoff coefficient Pervious (C1) =

0.25

Runoff coefficient Impervious (C2) =

0.95

C = [(A1 x C1) + (A2 x C2)] / A =	0.600
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A_{area} = Total Tributary Area = C x A3 =	0.18 ac
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F = Design Storm Frequency =

5 Year

T_{1"} =

19.11 Minutes

T_c = Time of concentration or time to reach 1 inlet =

10 Minutes

T_t = Time to generate one inch of runoff plus the time of concentration	29.11 Minutes
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Per Table 3.3-1 Excerpt of Table T-16 from the FDOT Hydrology Handbook - January 2004:

Within Rainfall Zone 10, in Miami-Dade County for a 10-year storm frequency, the polynomial coefficients

A = 11.1908

B = -0.93165

C = -0.48526

D = 0.05836

Equation 3.3-10: $S L + 60 E_t L T_t = 60 C A_{area} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t$

OR: $L = \{60 C A_{area} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t\} / (S + 60 E_t T_t)$

Equation 3.3-11: $E_t L = C A_{area} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3])$ OR:

$$L = \{C A_{area} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3])\} / E_t$$

Where:

L = Length of Exfiltration Trench, LF

t = Rainfall duration, min



FRENCH DRAIN CALCULATIONS

(NE 111TH ST)

Use Excel *Solver* to find t when $L_{3.3-10} = L_{3.3-11}$

$L_{3.3-10} = 106.75$ LF

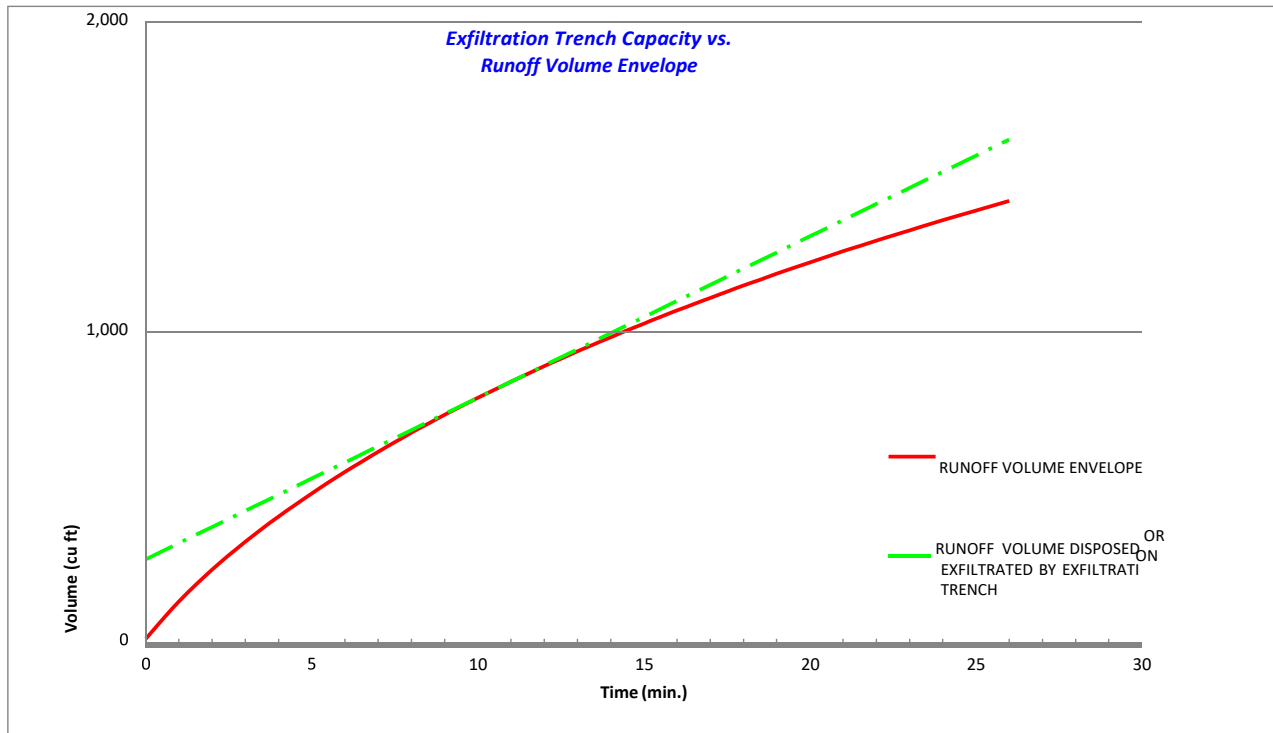
$L_{3.3-11} = 106.75$ LF

$L_{3.3-10} - L_{3.3-11} = 0.00$

$t = 10.56$ Minutes

THEREFORE,

LENGTH OF EXFILTRATION TRENCH REQUIRED =	106.75 LF
LENGTH OF EXFILTRATION TRENCH PROVIDED =	147 LF
FACTOR OF SAFETY PROVIDED =	1.38





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CONCEPTUAL DRAINAGE CALCULATIONS

Biscayne Park - Phase 1A Drainage Design Criteria Package

(NE 113TH STREET)

Village of Biscayne Park, Florida

Prepared For:

Village of Biscayne Park

Prepared By:



Calvin, Giordano & Associates, Inc.

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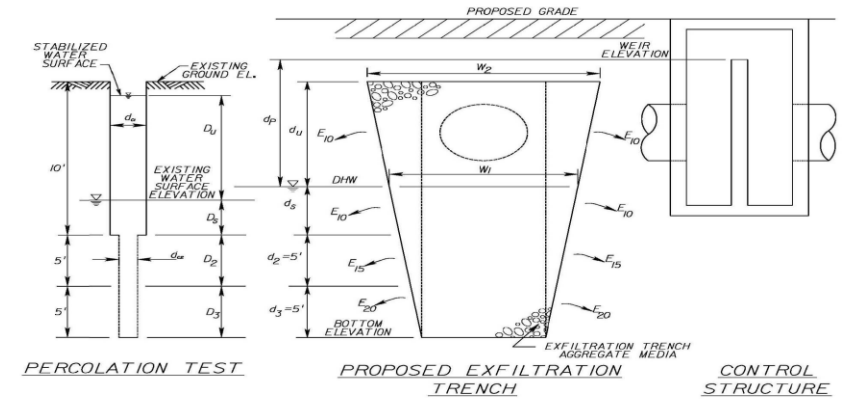
FRENCH DRAIN CALCULATIONS

(NE 113 STREET)

DESIGN ELEVATIONS:

Weir Elevation/control elevation	=	3 ft NGVD
Existing Grade Elevation	=	3 NGVD
Design High Water Elevation (DHW)	=	1.8 ft NGVD (October Water Table Elevation)
Top of Trench Elevation	=	2 ft NGVD
Bottom of Trench Elevation	=	-12.00 ft NGVD
Unsaturated Trench depth (d_u)	=	0.2 ft

EXFILTRATION RATE CALCULATIONS:



The design high water elevation and the control elevation are within the aggregate

media. E_t = Total exfiltration rate per foot of trench, cfs/LF

For 15-ft deep exfiltration trench:

$$E_t = 2 K_{10} [d_u (d_p - d_u/2) + d_s d_p] + 2 d_p d_2 K_{15}$$

(Equation 2.6-2, Exfiltration Trench Reference Manual-January 2008, Florida Department of Transportation District-6)

K_{10} =	Hydraulic Conductivity at 10 ft depth =	2.49E-04 cfs/ft ² /ft of
K_{15} =	Hydraulic Conductivity at 15 ft depth =	2.49E-04 head cfs/ft ² /ft
d_1 =	Depth of Trench within 10 ft stratum =	9.00 of head ft
d_2 =	Depth of Trench within 10-15 foot Stratum =	5 ft

d_p = Hydraulic Head on Exfiltration trench = 1.2 ft

d_u = Depth of the Unsaturated Zone = 0.2 ft

d_s = Depth of the Saturated Zone = 8.80 ft

E_t = Total exfiltration rate per LF of trench (Calculated) = 0.0084 cfs/LF

E_t = Total exfiltration rate per LF of trench (Design) = 0.0084 cfs/LF



FRENCH DRAIN CALCULATIONS

(NE 113 STREET)

EXFILTRATION LENGTH CALCULATIONS:

According to the Florida Department of Transportation - District 6 Exfiltration Trench Reference Manual, January 2008 - Ver.1.08, the Minimum Exfiltration Length Required to meet the Water Quality and Quantity for the design storm shall satisfy the following equations:

$$S L + 60 E_t L T_t = 60 C A_{\text{area}} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t \quad \text{.....Equation 3.3-10 } E_t L$$

$$= C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3]) \quad \text{.....Equation 3.3-11}$$

Where:

S = Storage in trench, ft³ per LF of trench

$$S = (W d_u - A - A_s) \times 0.5 + (A - A_s)$$

$$S = (W d_u - [\pi/4 D^2 - 1/2 r^2 (\theta/180 - \sin\theta)]) \times 0.5 + [\pi/4 D^2 - 1/2 r^2 (\theta/180 - \sin\theta)]$$

W = Average trench width =

4 ft

D = Diameter of perforated pipe =

1.5 ft

A = Available Storage area in perforated pipe =

1.767 ft²

A_s = Submerged area of pipe =

1.767 ft²

S = Storage in trench per LF of trench =	0.400 ft³/LF
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T_t = Time to generate one inch of runoff plus the time of concentration

$$T_t = T_{1''} + T_c$$

$$T_{1''} = \text{Time to generate 1" of runoff, minutes} = (2940 F^{-0.11}) / (308.5C - 60.5 (0.5895 + F^{-0.67}))$$

C = Weighted runoff coefficient

Pervious Area (A1) =

0.3 ac

Impervious Area (A2) =

0.3 ac

Total Area (A3) =

0.6 ac

Runoff coefficient Pervious (C1) =

0.25

Runoff coefficient Impervious (C2) =

0.95

C = [(A1 x C1) + (A2 x C2)] / A =	0.600
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A_{area} = Total Tributary Area = C x A3 =	0.36 ac
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F = Design Storm Frequency =

5 Year

T_{1''} =

19.11 Minutes

T_c = Time of concentration or time to reach 1 inlet =

10 Minutes

T_t = Time to generate one inch of runoff plus the time of concentration	29.11 Minutes
---	----------------------

Per Table 3.3-1 Excerpt of Table T-16 from the FDOT Hydrology Handbook - January 2004:

Within Rainfall Zone 10, in Miami-Dade County for a 10-year storm frequency, the polynomial coefficients

A = 11.1908

B = -0.93165

C = -0.48526

D = 0.05836

Equation 3.3-10: $S L + 60 E_t L T_t = 60 C A_{\text{area}} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t$

OR: $L = \{60 C A_{\text{area}} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t\} / (S + 60 E_t T_t)$

Equation 3.3-11: $E_t L = C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3])$ OR:

$$L = \{C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3])\} / E_t$$

Where:

L = Length of Exfiltration Trench, LF

t = Rainfall duration, min



FRENCH DRAIN CALCULATIONS

(NE 113 STREET)

Use Excel *Solver* to find t when $L_{3.3-10} = L_{3.3-11}$

$L_{3.3-10} = 329.11$ LF

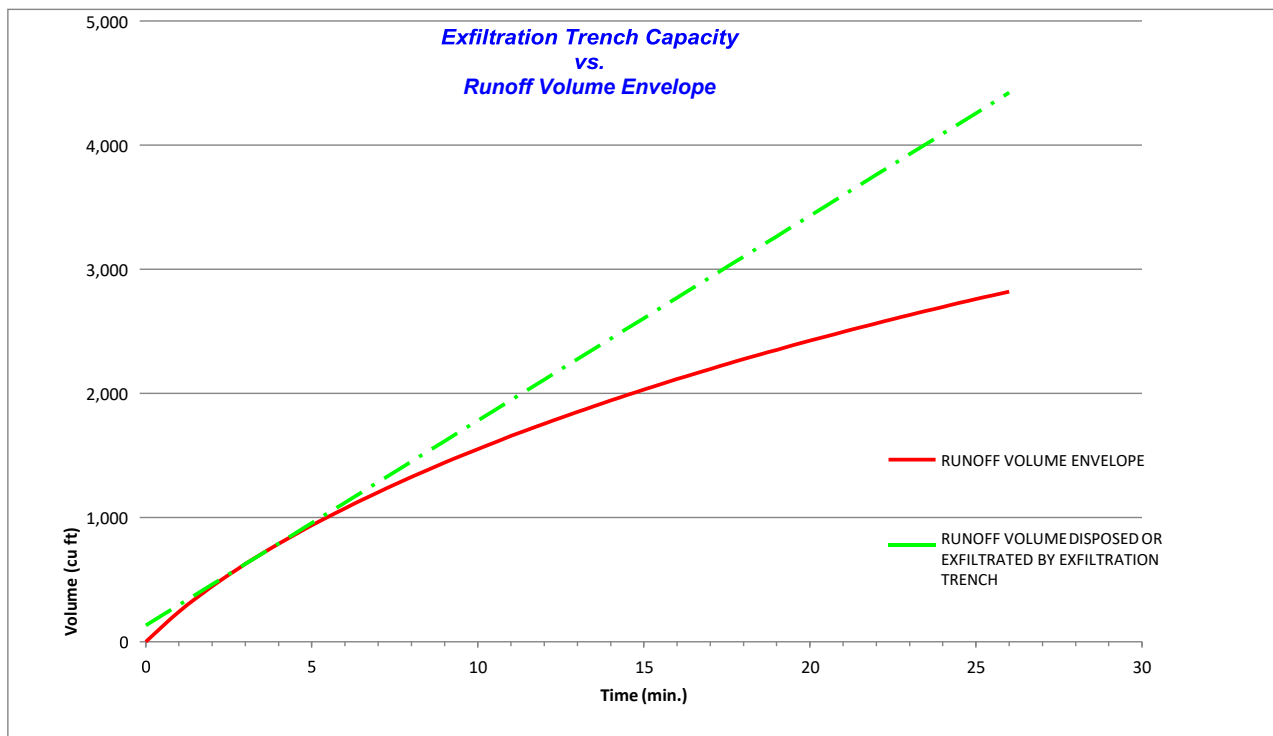
$L_{3.3-11} = 329.11$ LF

$L_{3.3-10} - L_{3.3-11} = 0.00$

$t = 3.31$ Minutes

THEREFORE,

LENGTH OF EXFILTRATION TRENCH REQUIRED =	329.11 LF
LENGTH OF EXFILTRATION TRENCH PROVIDED =	370 LF
FACTOR OF SAFETY PROVIDED =	1.12





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CONCEPTUAL DRAINAGE CALCULATIONS

Biscayne Park - Phase 1A Drainage Design Criteria Package (NE 115TH STREET) Village of Biscayne Park, Florida

Prepared For:

Village of Biscayne Park

Prepared By:



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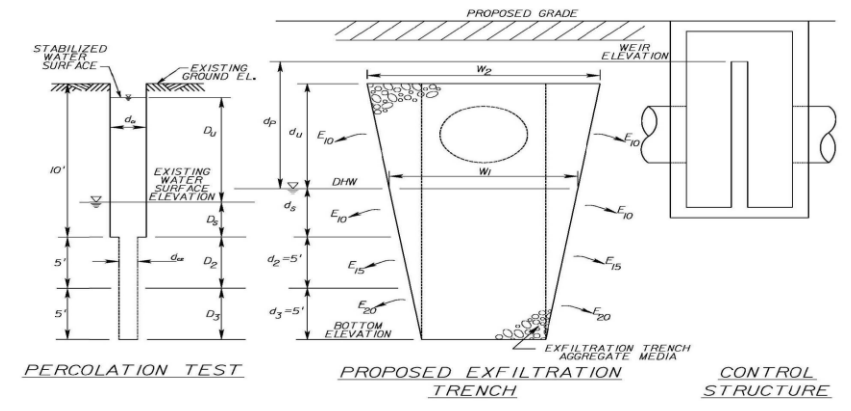
FRENCH DRAIN CALCULATIONS

(NE 115 STREET)

DESIGN ELEVATIONS:

Weir Elevation/control elevation	=	3 ft NGVD
Existing Grade Elevation	=	5 NGVD
Design High Water Elevation (DHW)	=	1.8 ft NGVD (October Water Table Elevation)
Top of Trench Elevation	=	2.5 ft NGVD
Bottom of Trench Elevation	=	-10.00 ft NGVD
Unsaturated Trench depth (d_u)	=	0.7 ft

EXFILTRATION RATE CALCULATIONS:



The design high water elevation and the control elevation are within the aggregate

media. E_t = Total exfiltration rate per foot of trench, cfs/LF

For 15-ft deep exfiltration trench:

$$E_t = 2 K_{10} [d_u (d_p - d_u/2) + d_s d_p] + 2 d_p d_2 K_{15}$$

(Equation 2.6-2, Exfiltration Trench Reference Manual-January 2008, Florida Department of Transportation District-6)

K_{10} =	Hydraulic Conductivity at 10 ft depth =	1.59E-03 cfs/ft ² /ft of
K_{15} =	Hydraulic Conductivity at 15 ft depth =	1.59E-03 head cfs/ft ² /ft
d_1 =	Depth of Trench within 10 ft stratum =	7.50 of head ft
d_2 =	Depth of Trench within 10-15 foot Stratum =	5 ft

d_p =	Hydraulic Head on Exfiltration trench =	1.2 ft
d_u =	Depth of the Unsaturated Zone =	0.7 ft
d_s =	Depth of the Saturated Zone =	6.80 ft

E_t =	Total exfiltration rate per LF of trench (Calculated) =	0.0469 cfs/LF
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E_t =	Total exfiltration rate per LF of trench (Design) =	0.0469 cfs/LF
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FRENCH DRAIN CALCULATIONS

(NE 115 STREET)

EXFILTRATION LENGTH CALCULATIONS:

According to the Florida Department of Transportation - District 6 Exfiltration Trench Reference Manual, January 2008 - Ver.1.08, the Minimum Exfiltration Length Required to meet the Water Quality and Quantity for the design storm shall satisfy the following equations:

$$S L + 60 E_t L T_t = 60 C A_{\text{area}} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t \quad \text{.....Equation 3.3-10 } E_t L$$

$$= C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3]) \quad \text{.....Equation 3.3-11}$$

Where:

S = Storage in trench, ft³ per LF of trench

$$S = (W d_u - A - A_s) \times 0.5 + (A - A_s)$$

$$S = (W d_u - [\pi/4 D^2 - 1/2 r^2 (\theta/180 - \sin\theta)]) \times 0.5 + [\pi/4 D^2 - 1/2 r^2 (\theta/180 - \sin\theta)]$$

W = Average trench width =

4 ft

D = Diameter of perforated pipe =

1.5 ft

A = Available Storage area in perforated pipe =

1.767 ft²

A_s = Submerged area of pipe =

1.767 ft²

S = Storage in trench per LF of trench =	1.400 ft³/LF
---	--------------------------------

T_t = Time to generate one inch of runoff plus the time of concentration

$$T_t = T_{1"} + T_c$$

$$T_{1"} = \text{Time to generate 1" of runoff, minutes} = (2940 F^{-0.11}) / (308.5C - 60.5 (0.5895 + F^{-0.67}))$$

C = Weighted runoff coefficient

Pervious Area (A1) =

1.5 ac

Impervious Area (A2) =

1.5 ac

Total Area (A3) =

3 ac

Runoff coefficient Pervious (C1) =

0.25

Runoff coefficient Impervious (C2) =

0.95

C = [(A1 x C1) + (A2 x C2)] / A =	0.600
--	--------------

A_{area} = Total Tributary Area = C x A3 =	1.8 ac
---	---------------

F = Design Storm Frequency =

5 Year

T_{1"} =

19.11 Minutes

T_c = Time of concentration or time to reach 1 inlet =

10 Minutes

T_t = Time to generate one inch of runoff plus the time of concentration	29.11 Minutes
---	----------------------

Per Table 3.3-1 Excerpt of Table T-16 from the FDOT Hydrology Handbook - January 2004:

Within Rainfall Zone 10, in Miami-Dade County for a 10-year storm frequency, the polynomial coefficients

A = 11.1908

B = -0.93165

C = -0.48526

D = 0.05836

Equation 3.3-10: $S L + 60 E_t L T_t = 60 C A_{\text{area}} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t$

OR: $L = \{60 C A_{\text{area}} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t\} / (S + 60 E_t T_t)$

Equation 3.3-11: $E_t L = C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3])$ OR:

$$L = \{C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3])\} / E_t$$

Where:

L = Length of Exfiltration Trench, LF

t = Rainfall duration, min



FRENCH DRAIN CALCULATIONS

(NE 115 STREET)

Use Excel *Solver* to find t when $L_{3.3-10} = L_{3.3-11}$

$L_{3.3-10} = 319.17$ LF

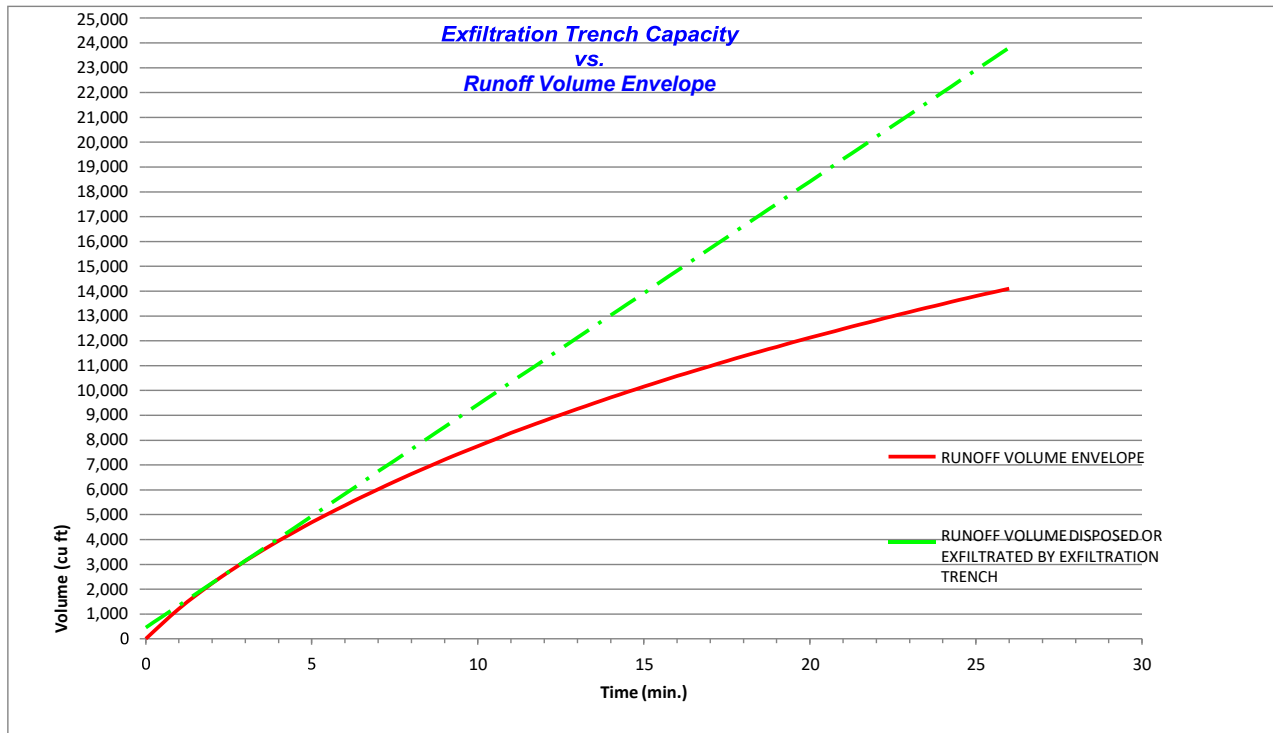
$L_{3.3-11} = 319.17$ LF

$L_{3.3-10} - L_{3.3-11} = 0.00$

$t = 2.48$ Minutes

THEREFORE,

LENGTH OF EXFILTRATION TRENCH REQUIRED =	319.17 LF
LENGTH OF EXFILTRATION TRENCH PROVIDED =	516 LF
FACTOR OF SAFETY PROVIDED =	1.62





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CONCEPTUAL DRAINAGE CALCULATIONS

Biscayne Park - Phase 1A Drainage Design Criteria Package

(NE 121st STREET)

Village of Biscayne Park, Florida

Prepared For:

Village of Biscayne Park

Prepared By:



Calvin, Giordano & Associates, Inc.

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August 2021

This item has been digitally signed and sealed by Mohammed Sharifuzzaman, P.E. on 08/13/2021. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Mohammed Sharifuzzaman, P.E.
FL P.E. License Number 67640



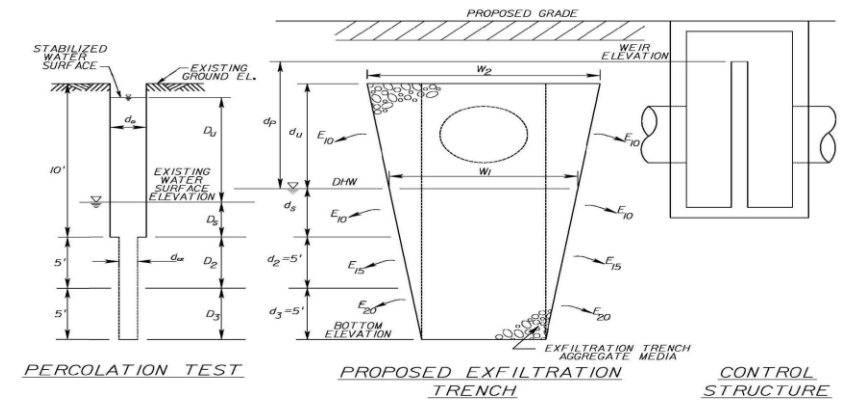
FRENCH DRAIN CALCULATIONS

(NE 121 ST)

DESIGN ELEVATIONS:

Weir Elevation/control elevation	=	2 ft NGVD
Existing Grade Elevation	=	3 NGVD
Design High Water Elevation (DHW)	=	1.8 ft NGVD (October Water Table Elevation)
Top of Trench Elevation	=	1.8 ft NGVD
Bottom of Trench Elevation	=	-12.00 ft NGVD
Unsaturated Trench depth (d_u)	=	0 ft

EXFILTRATION RATE CALCULATIONS:



The design high water elevation and the control elevation are within the aggregate

media. E_t = Total exfiltration rate per foot of trench, cfs/LF

For 15-ft deep exfiltration trench:

$$E_t = 2 K_{10} [d_u (d_p - d_u/2) + d_s d_2] K_{15}$$

(Equation 2.6-2, Exfiltration Trench Reference Manual-January 2008, Florida Department of Transportation District-6)

K_{10} =	Hydraulic Conductivity at 10 ft depth =	7.27E-04 cfs/ft ² /ft of
K_{15} =	Hydraulic Conductivity at 15 ft depth =	7.27E-04 head cfs/ft ² /ft
d_1 =	Depth of Trench within 10 ft stratum =	8.80 of head ft
d_2 =	Depth of Trench within 10-15 foot Stratum =	5 ft

d_p = Hydraulic Head on Exfiltration trench = 0.2 ft

d_u = Depth of the Unsaturated Zone = 0 ft

d_s = Depth of the Saturated Zone = 8.80 ft

E_t = Total exfiltration rate per LF of trench (Calculated) = 0.0040 cfs/LF

E_t = Total exfiltration rate per LF of trench (Design) = 0.0040 cfs/LF



FRENCH DRAIN CALCULATIONS

(NE 121 ST)

EXFILTRATION LENGTH CALCULATIONS:

According to the Florida Department of Transportation - District 6 Exfiltration Trench Reference Manual, January 2008 - Ver.1.08, the Minimum Exfiltration Length Required to meet the Water Quality and Quantity for the design storm shall satisfy the following equations:

$$S L + 60 E_t L T_t = 60 C A_{\text{area}} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t \quad \text{.....Equation 3.3-10 } E_t L$$

$$= C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3]) \quad \text{.....Equation 3.3-11}$$

Where:

S = Storage in trench, ft³ per LF of trench

$$S = (W d_u - A - A_s) \times 0.5 + (A - A_s)$$

$$S = (W d_u - [\pi/4 D^2 - 1/2 r^2 (\theta/180 - \sin\theta)]) \times 0.5 + [\pi/4 D^2 - 1/2 r^2 (\theta/180 - \sin\theta)]$$

W = Average trench width =

4 ft

D = Diameter of perforated pipe =

1.5 ft

A = Available Storage area in perforated pipe =

1.767 ft²

A_s = Submerged area of pipe =

1.767 ft²

S = Storage in trench per LF of trench =	0.000 ft³/LF
---	--------------------------------

T_t = Time to generate one inch of runoff plus the time of concentration

$$T_t = T_{1''} + T_c$$

$$T_{1''} = \text{Time to generate 1" of runoff, minutes} = (2940 F^{-0.11}) / (308.5C - 60.5 (0.5895 + F^{-0.67}))$$

C = Weighted runoff coefficient

Pervious Area (A1) =

0.07 ac

Impervious Area (A2) =

0.07 ac

Total Area (A3) =

0.14 ac

Runoff coefficient Pervious (C1) =

0.25

Runoff coefficient Impervious (C2) =

0.95

C = [(A1 x C1) + (A2 x C2)] / A =	0.600
--	--------------

A_{area} = Total Tributary Area = C x A3 =	0.084 ac
---	-----------------

F = Design Storm Frequency =

5 Year

T_{1''} =

19.11 Minutes

T_c = Time of concentration or time to reach 1 inlet =

10 Minutes

T_t = Time to generate one inch of runoff plus the time of concentration	29.11 Minutes
---	----------------------

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OR: $L = \{60 C A_{\text{area}} [A + B \ln(t) + C (\ln(t))^2 + D (\ln(t))^3] t\} / (S + 60 E_t T_t)$

Equation 3.3-11: $E_t L = C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3])$ OR:

$$L = \{C A_{\text{area}} (A + B [\ln\{t\} + 1] + C \ln\{t\} [\ln\{t\} + 2] + D \ln\{t\}^2 [\ln\{t\} + 3])\} / E_t$$

Where:

L = Length of Exfiltration Trench, LF

t = Rainfall duration, min



FRENCH DRAIN CALCULATIONS

(NE 121 ST)

Use Excel *Solver* to find t when $L_{3.3-10} = L_{3.3-11}$

$L_{3.3-10} = 242.73$ LF

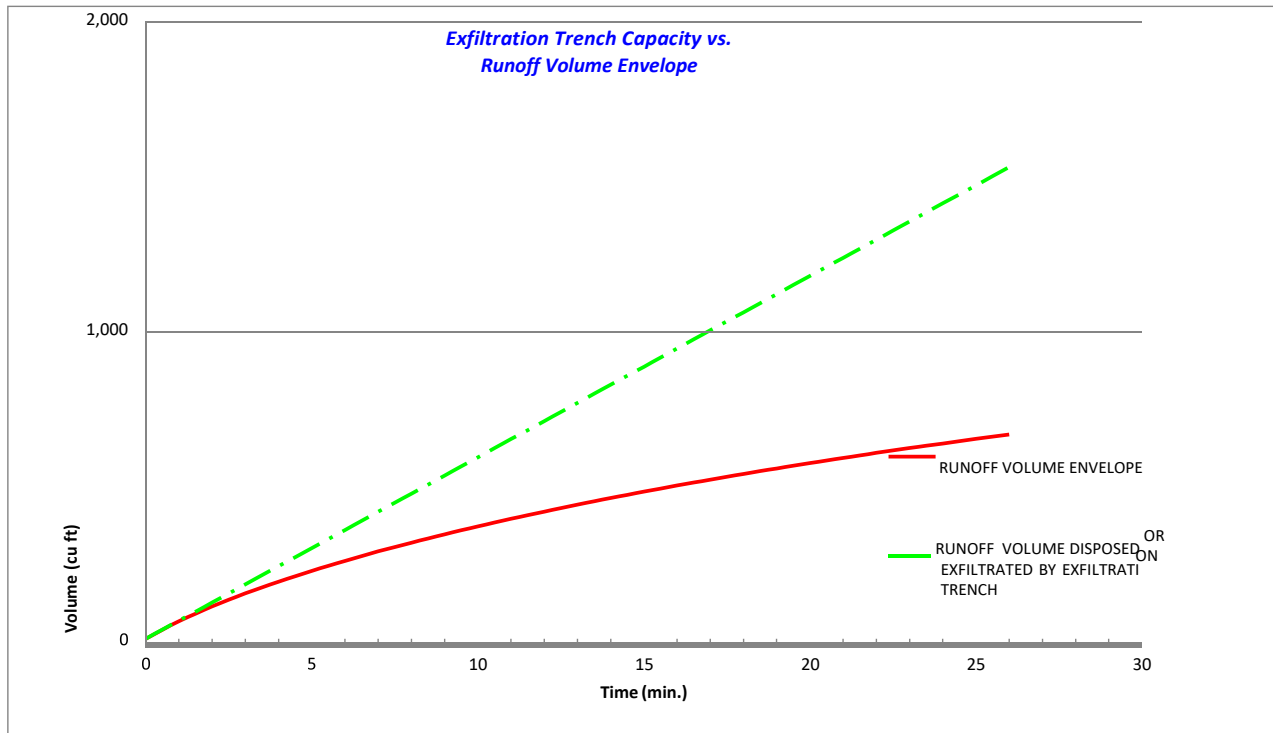
$L_{3.3-11} = 242.73$ LF

$L_{3.3-10} - L_{3.3-11} = 0.00$

$t = 0.43$ Minutes

THEREFORE,

LENGTH OF EXFILTRATION TRENCH REQUIRED =	242.73 LF
LENGTH OF EXFILTRATION TRENCH PROVIDED =	102 LF
FACTOR OF SAFETY PROVIDED =	0.42





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